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# Shipyard Trade Skill Testing Program

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IXB-2

The eight naval shipyard, in conjunction with the Naval Sea Systems Command have developed a system of written and performance tests applicable to journeymen level production workers. These tests were developed in compliance with the government's Uniform Guidelines on Selection Procedures and submitted to the U.S. Office of Personnel Management for approval. Four specific applications are envisioned for the tests: (1) Promotion of worker-grade personnel to journeyman positions; (2) Hiring experienced personnel from outside the federal government; (3) Identification of requirements for either additional or remedial training of apprentices; and (4) Identification of deficiencies in personnel training programs. Growth plans for the programs include progress test for apprentice programs, measurement associated with qualifications on new procedures, and certification in lieu of training on certain repetitive programs.

Tests have been developed for seventeen trades and validated by trial administrations at each of the naval ship yards. As part of the development process a task analysis was performed for each of the trades. Computer programs used for test generation allow the test designer to specify which tasks are to be measured in any given test and allow the tests to accommodate differences in job content and procedures at the several locations. Scoring and analysis features are also included in the computerized testing programs.

The task analysis and the computer programs are in the public domain. As such they can be made available to commercial shipyards with potential testing applications.

## NOMENCLATURE

The following acronyms and abbreviations are used in this paper.

NAVSEA	Naval Sea Systems Command Headquarters
NAVSHIPYD SJOSE	San Jose Naval Shipyard

SSTS	Shipyard Skills-Tracking System
TSD	Trade-Skill Designator
USTIS	Uniform Shipyard Training Information System
SD	Supervisor's Desk
OPM	u. s. office of Personnel Management
FPM 335-1	Federal Personnel Manual Supplement 335-1
OCPM	Department of the Navy Office of Civilian Personnel Management

## INTRODUCTION

The Naval Sea Systems Command Headquarters (NAVSEA) is working with the eight naval shipyards to develop batteries of written and performance tests that can be used to measure production worker's capabilities of accomplishing assigned shipwork. The tests are intended to help shipyards to assign the right personnel to complex jobs; to determine the best sections within each trade to assign newly-hired personnel; to determine what specialized training trade personnel require; to assess the efficacy of trade training programs; and, upon approval by the U.S. Office of Personnel Management (OPM), to make informed decisions in selection and promotion of trade personnel.

## SCENARIO

The scene is just a short time from now at the (fictitious) San Jose Naval Shipyard (NAVSHIPYD SJOSE). A project team has just assembled at its

production worksite to prepare to accomplish its first assigned job on an SSN-688-class submarine refueling overhaul. The members have been selected because the automated Shipyard Skills-Tracking System (SSTS) [already in operation in seven of the eight real naval shipyards] has shown that they possess the appropriate Trade-Skill Designators (TSDs) [under active development in the real world] and that they possess the requisite formal qualifications to perform a number of the tasks their assigned job will entail.

Despite their qualifications, however, this job will involve accomplishment of a number of tasks that none of them has ever performed; some of these tasks are so sensitive to error (and improper performance would be so expensive to correct) that the team-and the shipyard-need to be absolutely certain that those who perform them are fully competent to do so. In addition, none of the team members has ever worked a job before following the precepts of zone technology, nor have any of them worked outside the boundaries of the specific trades in which they were trained. Working in this manner will entail a significant cultural change for them.

a. Having rounded up and reviewed all of the required technical documentation for the job, the team begins to parcel out work assignments to its individual team members. Willie, the team leader says to Joe, an electronics mechanic: "Joe, you clearly have the best background to perform Task 03.4. And the job will be performed most efficiently if you also perform associated tasks 03.3 and 03.5. But you've never performed those specific tasks before. So here's what we're going to do."

b. Willie turns to a video work station that has been brought to the worksite. When she touches the screen, a menu pops up. From the menu, she selects "enter task assignments." Following the directions on the screen, she enters Joe's badge number and task numbers 03.3, 4, and 5. From a menu, she then selects "task training and testing" and selects task number 03.3 as the starting point. Turning back to Joe, she says "Go for it!"

c. Joe sits down at the work station, which contains a microcomputer containing a 702-megabyte hard drive capable of storing, digitally, as many as 72 minutes of full-motion video (or combinations of motion video, still video, computer graphics, and text). Upon pressing the "enter" key, he is administered a brief pre-test of what he knows about how to perform task 03.3. The pre-test reveals that, while Joe is well-versed in most aspects of the task, he is unfamiliar with a couple of the specifications he must meet in accomplishing the task

d. To assure that Joe will have the requisite knowledge to perform task 03.3, the video/computer system administers a tutorial to him on the

knowledge requirements of task 03.3, with test questions built into the lesson. Joe views the lesson, answering the questions as they come up by touching the choices listed on the screen. When he picks a wrong answer, the system sends him back to review the part of the lesson containing the material he failed to master. If Joe misses the right answer to the same test question a second time, he is sent back to review the problem material once again-but this time, the content is presented to him in a different way, on the assumption that there was something about its presentation the first two times that didn't fit Joe's learning style. If the test question measures knowledge that is essential to correct performance of task 03.3, Joe is not permitted to progress through the lesson until he has demonstrated that he has acquired that knowledge

e. Once having completed the lesson for task 03.3, the interactive-multimedia system--for that, in fact, is the current name for the kind of system Joe is training on--moves Joe into a pre-test for task 03.4. Because the shipboard system on which Joe will be working is so sensitive to error, it is essential that task 03.4 be performed correctly in every detail; the passing grade for the lesson on task 03.4 is therefore set at 100 percent. Joe, however, is experienced at performing the task and answers all the questions in the lesson correctly the first time. The system therefore notifies the Shipyard Skills-Tracking System (SSTS) to update Joe's qualification records to show that he has requalified for task 03.4 as of this date, and it moves Joe into the lesson for task 03.5.

f. Task 03.5 is an installation process that requires performance of a number of work steps in a precise sequence. Joe is therefore shown a video of a mechanic performing the task; in the video, the key work steps are shown in slow motion and repeated several times, while the audio describes the steps being performed and why it is important that they be performed as shown. Joe is then tested by being shown a video of a mechanic performing the task at normal speed; Joe is asked to touch the screen if he sees a mistake being made. He is next required to walk through a simulation of the task, performing all of its worksteps, in sequence, by touching the objects shown on the screen at the appropriate times.

g. Joe successfully completes the simulation of task 03.5 and reports to his team leader. The team leader goes to the workstation, identifies herself to the system, and asks for a report on Joe's performance. The system displays Joe's grades on the lessons for task 03.3, 03.4, and 03.5, including, if the team leader asks for it, how many attempts Joe required on each question or each lesson before passing it. Satisfied that Joe is fully prepared to accomplish the three tasks, the team leader directs Joe to begin work.

h. When Joe gets to task 03.5, he wants to make sure he performs its complicated work steps in the

sequence demanded. He turns to the work station and calls up the task. He then watches the mechanic on the screen perform each step; puts the system on “pause”; mimics on the real ship component what he has just seen; restarts the system and repeats the process with each succeeding work step, thereby ensuring that he has left nothing to memory or chance.

i. Upon completion of the three task (and of any post-performance inspections required), Joe inserts his badge into a slot in the work station. This causes real-time work-status updates in Supervisor’s Desk [currently under development in the real world] and in the shipyard’s central management-information system modules; it also further updates Joe’s qualification and experience records in SSTS and his training records in the Uniform Shipyard Training Information System(USTIS) [another system that is currently under development].

DISCUSSION

The foregoing scenario describes how “just-in time”delivery of training could work in a shipyard. Some of the dividends shipyards would reap are obvious, such as virtual elimination of the problem of mental retention of knowledge and skills imparted through training. Other benefits might not be as readily apparent, such as the fact that the blurring of the distinction between training, on the one hand, and job preparation and performance, on the other, will likely make it possible for much of this training to be charged directly to ship customers, rather than to overhead.

Testing plays an intimate and prominent role in this kind of training. Testing is integral to the process of preparing personnel to accomplish ship repair work and to determining the relative competencies of those available to do the work. The repair of modern naval ships and submarines has become so sophisticated, and the consequences of error so significant, that to leaving to chance the capabilities of those performing ship repairs and alterations is not acceptable. NAVSEA through its Trade-Skill Testing Program is therefore making available to the naval shipyards validated written and performance

tests to assess the job proficiency of its wage-grade workers in these skilled trades. Occupational tests--i.e., tests that assess whether those tested are capable of performing as journeyman mechanics in their respective trades--have been issued for use in the promotion, selection, placement, and training of shipyard employees in 17 major skilled trades. The tests may not be used in promotions or in selection of applicants from outside the testing shipyard without the tests having first been approved for these uses by OPM, a process that is underway.] The 17 trades covered are shown in figure 1.

A Trade-Skill Testing Program Users’ Manual has been issued to the naval shipyards. It contains guidelines that are designed to be consistent with current federal and Navy regulations governing the selection and promotion of employees, such as FPM 335-I. It should be emphasized that these are guidelines, not mandatory requirements. Naval shipyards have the option of deviating from the guidelines as long as their deviations are consistent with current Navy and federal personnel regulations. A companion manual, the Examiner’s Manual, provides detailed instructions for administering and scoring of the tests.

The trade-skill tests have been validated under the requirements of FPM 335-I and have been approved by NAVSEA for use in the naval shipyards under delegated authority from Navy’s Office of Civilian Personnel Management (OCPM).

The occupational examinations may be used in the following ways:

- 1. To promote current shipyard workers (apprentices and “limited” workers) to journeyman-level jobs.
- 2. To select and place external applicants with trade experience in journeyman-level jobs.
- 3. To determine the training needs of the present workforce.
- 4. To evaluate the effectiveness of apprentice and other training programs.

It is important to note that NAVSEA has laid down the policy that the tests are not to be used for adverse personnel actions, such as firing and demotions.

Air-conditioning Equipment Mechanic	Boilermaker
Electrician	Electronics Mechanic
Electroplater	Fabric Worker
Insulator	Inside Machinist
Ordnance Equipment Mechanic	Outside Machinist
Painter	Pipefitter
Rigger	Sheetmetal Mechanic
Shipfitter	Shipwright
Welder	

Figure 1. The 17 trades for which occupational tests have been developed.

## NATURE OF THE TESTS

The set of tests for each trade consists of a multiple-choice written examination and a "hands-on" performance test. This was done, in part, because the U.S. Office of Personnel Management will not permit use of written examinations alone in selection and promotion actions. (This policy stems from evidence that written tests, when used alone, may have an adverse impact upon socio-economically disadvantaged applicants)

The written tests in each trade consist of 100 to 150 multiple-choice questions that assess trade knowledge and ability to apply such knowledge. The tests take approximately two hours each to administer.

The performance, or practical, tests measure job skills, using actual tools and equipment of the trade. The performance tests take approximately one to four hours to administer.

## DEVELOPMENT OF THE TESTS

Professional test designers were hired to shepherd development of the tests. This was done to ensure that the tests maintained both face validity and content validity; that every test item would be validated against essential job requirements; and that the tests met the standards of the federal government's Uniform Guidelines on Employee Selection Procedures. This kind of rigor was necessary to the securing of OPM approval of the tests and to precluding grievances and litigation. If grievances or litigation against the tests should occur, the tests can be defended on the basis that they measure knowledge and skills that are essential to competent job performance.

The tests were developed by panels of representatives of the 17 trades, guided by the professional test designers. As part of the development process, a task analysis was performed for each of the trades. This analysis divided the trade into several major duties; identified tasks within the duties; and identified the knowledge and skills required for a worker to perform each task competently at the journeyman level. (The task analyses were designed to accommodate differences in procedures and job content within the same trade among the eight naval shipyards.)

Each of the written test items is tied to the task analysis and has also been referenced, wherever possible, to applicable technical specifications.

Once written, the test items were loaded into a computerized test-item data bank. Computer programs have been written that enable semi-automated test generation: the test designer has merely to specify which task are to be measured in a given test,

and the computer assembles appropriate test items into a new test. Other computer programs include automated test analysis and scoring of test answer sheets.

All of the tests were administered on a trial basis to journeymen at the naval shipyards and were revised to ensure that they are reliable, fair, and valid measures of trade-skill and knowledge.

## CONCLUSION

Following implementation of the initial 17 occupational trade-skill tests, NAVSEA plans to begin development of two additional kinds of tests:

### Progress Tests

Progress tests will be developed to be administered to apprentices every six months, as they become eligible for their semiannual promotions. These tests will give shipyards a clearer picture of the efficacy of their apprentice training programs and should also serve to spur production shops toward greater conscientiousness in managing the rotation of apprentices among the skills of their trades.

### Specialized Tests

Specialized tests in advanced technical skills will be developed. Examples of such tests include tests of mechanics' ability to perform jobs never before accomplished at a particular shipyard; tests of ability to perform the work involved in a complex ship alteration (ShipAlt); and tests of competence on jobs that have been generating rework; and, of course, tests to be integrated into the fabric of interactive work qualification and assignment process described in the scenario that opened this paper.

## ACKNOWLEDGEMENT

The author was assisted in the preparation of this paper by Lieutenant Commander C. Lee Walker, USN (Retired).

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- 1 ***Trade-Skill Test Users' Manual*** (draft), Washington, D.C., Naval Sea Systems Command, June 1990.
2. ***Uniform Guidelines for Employee Selection Procedures***, FPM Supplement 271-2, Washington, D.C., United States Office of Personnel Management, August 31, 1979.

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